Significance of Clinical and Demographic Data in Short-term Prediction of Cardiac Risk in Older Patients after Major Non-cardiac Surgery

M Golubović[1], V Perić[2], M Lazarević[3], D Milić[3, 4], V Karanikolić[5, 6], M Stojanović[7, 8], V Stoičkov[9, 10], D Krtinić[11, 12], D Zlatanović[13], I Budić[1, 14]

ABSTRACT

Objective: The aim of this study is to estimate significance of preoperative clinical and demographic data and risk factors in prediction of short-term mortality in older patients after major non cardiac surgery.

Methods: This prospective, one-center, observational study entered 81 patients undergoing major non-cardiac surgery at Clinical Center Nis, Serbia. The initial clinical assessment of patients involved medical history, physical examination, cardiac ultrasonography, general haematology and biochemical tests, pulse oximetry, and chest X-ray. Patients were followed by the consulting physicians until discharge or up to 30 days after surgery. The end-point of study was to estimate all-cause mortality.

Results: The research included 81 patients (42 women – 51. 90% and 39 men – 48.10%). Average age was 71.30 ± 6.62 years. Within 30 days, 14 patients died in the tested population (17.30%). Ventricular fibrillation happened in six patients (10.9%) without risk factors, three patients with one risk factor (23.10%) and six patients with two risk factors (46.20%). A statistically significant difference was determined in the frequency of ventricular fibrillation in relation to the number of risk factors ($X^2 = 7.728$, $p = 0.021$). Five patients (9.10%) without risk factors died, three patients (23.10%) with one risk factor and six patients (46.20%) with two risk factors. A statistically significant difference was determined in the frequency of fatal outcome in relation to the number of risk factors ($X^2 = 9.078$, $p = 0.011$).

Conclusion: Patients with only two of large palette of preoperative risk factors have statistically significant higher short-term mortality.

Keywords: Elderly patients, non-cardiac surgery, risk factors, short-term mortality

From:[1]Center for Anesthesiology and Reanimatology, Clinical Center Nis, Nis, Serbia, [2]Medical School University of Nis, [3]Clinic for Cardiosurgery, Clinical Center Nis, [4]Department for Surgery, Faculty of Medicine, University of Nis, [5]Department for Dermatovenerology, Faculty of Medicine, University of Nis, [6]Clinic for Dermatovenerology, Clinical Center Nis, [7]Institute for Public Health Nis, [8]Department for Medical Statistics, Faculty of Medicine, University of Nis, [9]Institute Niska Banja, [10]Department for Internal Medicine, Faculty of Medicine, University of Nis, [11]Department for Pharmacology and Toxicology, Faculty of Medicine, University of Nis, [12]Clinic for Oncology, Clinical Center Nis, [13]Clinic for Physical Medicine and Rehabilitation, Clinical Center Nis and [14]Department for Anestesiology and Reanimatology, Faculty of Medicine, University of Nis, Nis, Serbia.

Correspondence: Dr M Golubović, Center for Anesthesiology and Reanimatology Clinical Center Nis, Bul. Dr Zorana Djindjića No 48, 18000 Nis, Serbia. Email: mladjangolubovic@gmail.com

INTRODUCTION

The preoperative cardiac evaluation is an opportunity to start and improve pharmacologic therapy, perform adequate diagnostic and therapeutic procedures and initiate overall care to reduce not only perioperative risk but also short-term risks from cardiovascular complications. Fundamental aspiration is risk appraisal of myocardial infarction (MI) and heart failure (HF), which are the most frequent causes of morbidity and mortality in major non-cardiac surgery. According to ESC/ESA guidelines, major non-cardiac surgery has an estimated 30-day risk of cardiac death and myocardial infarction above 5% (1). Elderly patients have been remarkably rule out in major cardiovascular researches or these have included relatively healthy older populations (2). Raised mortality rate of perioperative myocardial infarction, incidence and lethality of coronary artery disease was observed in group of older patients (3, 4). Nonetheless, age cannot serve as an independent risk factor in estimation of major cardiac complications. Extensively used cardiac risk index for non-cardiac surgery is Revised Cardiac Risk Index (RSRI, Lee index).

Forecast of postoperative MI, HF, cardiac arrest and complete heart block were the objectives of his introduction (1, 5). Preoperative anaemia is additional risk factor associated with increased perioperative mortality in non-cardiac surgery (6). Systematic review of 31 cohort studies improved that patients with chronic renal impairment have a two-fold increase in mortality and cardiovascular complications after non-cardiac surgery (7). The aim of study is to estimate significance of preoperative clinical and demographic data and risk factors in prediction of short-term mortality in patients after major non-cardiac surgery.

METHODS

This prospective, one-center, observational study entered 81 patients undergoing major non-cardiac surgery. A total of 81 patients (55–87 years old) were enlisted during 2013 at General Surgery Clinic in the Clinical Center of Nis, Serbia. Inclusion principles were major non-cardiac surgery procedures (vascular, thoracic, orthopaedic and abdominal surgery) with general balanced anaesthesia. More than 50% of patients have each one of succeeding risk factors: family history of cardiac disease, CAD or hypertension. Exclusion principles were emergent surgery and the inability to understand or sign the informed consent.

The New York Heart Association (NYHA) classification was determinated for each patient (8). The end-point of the study was to estimate all-cause mortality. The initial clinical assessment of patients involved medical history, physical examination, cardiac ultrasonography, general haematology and biochemical tests, pulse oximetry and chest X-ray. The follow-up period after surgical procedure persisted until discharge or up to 30 days in hospital. Medical histories and death affidavits were used for assessment of postsurgical short-term mortality rates.

The research was authorised by Biomedical Ethics Committee of the Medical School, University of Nis and accomplished according to the principles of the Declaration of Helsinki. Written confirmation was realised from all of patients recruited in study. Mean and standard deviation were favoured for presentation of all data. Mann-Whitney test, *t*-test and Chi Square test were generally used. Hazard ratio (HR) and 95% confidence interval (95% CI) are presented for those statistical analyses. Statistical analyses were done with Statistical Package for the Social Sciences SPSS for Windows, Version 16.0. (SPSS Inc., Chicago, Illinois, USA), where *p*-value under 0.05 was recognised as a statistical

significance. Kaplan-Meier survival curve and cox regression analysis were performed in relation to the number of risk factors.

RESULTS

The research included 81 patients (42 women – 51. 90% and 39 men – 48.10%). The mean age of the patients is 71.30 ± 6.62 years (range 51–87). Within 30 days, 14 patients died in the tested population (17.30%). Among the deceased patients, six were men (42.90%) and eight were women (57.10%). There was no statistically significant difference in gender with respect to fatal outcome (p = 0.887). Examination of demographic and clinical characteristics (Table 1, 2) showed that there was no statistically significant difference in any tested parameter with respect to fatal outcome.

Table 1: Preoperative risk factors

Parameter	Number	%
Previous PCI*	2	2.50
Previous CABG†	0	
Atrial fibrillation	10	12.30
Previous stroke	5	6.20
Peripheral arterial disease	1	1.20
Liver diseases	4	4.90
Lung diseases	9	11.10
Tumour	40	49.40
Metabolic disorders	9	11.10
Hypertension	64	79.00
Hyperlipidaemia	13	16,00
DM‡	23	28,40
DMID§	6	7,40
Family history	44	54.30
Active smoker	12	14.80

Abbreviations: *PCI – Percutaneous coronary intervention; †CABG – Coronary artery by-pass graft; ‡DM – Diabetes mellitus; §DMID – Diabetes mellitus insulin dependent.

Table 2: Significance and frequency of preoperative risk factors in deceased and survivors

Parameter	Deceased n = 14	Survivors n = 67	*p*	
Gender (M/F)	6/8	33/34	0.020	0.887
Age	73.86±6.63	70.76±6.54	1.593	0.128
Previous PCI*	0	2 (3,00)		0.682*
Atrial fibrillation	1 (7,10)	9 (13,40)	0.042	0.838R
Previous stroke	0	5 (7,50)		0.377*
Peripheral arterial disease	0	1 (1,50)		0.827*
Liver diseases	2 (14,30)	2 (3,00)	1.203	0.273
Lung diseases	2 (14,30)	7 (10,40)	0.173	0.390
Tumour	9 (64,30)	31 (46,30)	0.869	0.351
Metabolic disorders	0	9 (13,40)		0.164*
Hypertension	10 (71,40)	54 (80,60)	0.164	0.685
Hyperlipidemia	2 (14,30)	11 (16,40)		0.603*
DM†	3 (21,40)	20 (29,90)	0.096	0.757
DMID‡	0	6 (9,00)	0.363	0.547
Family history	9 (64,30)	35 (52,20)	0.279	0.597
Active smoker	1 (7,10)	11 (16,40)	0.226	0.635

Abbreviations: *PCI – Percutaneous coronary intervention; †DM – Diabetes mellitus; ‡DMID – Diabetes mellitus insulin dependent.

Both survival and deceased group predominantly included patients with NYHA II (57.10%, *ie* 58.20%). The group of patients who died mostly included those with NYHA III, and the patients that survived mostly had NYHA I.

The use of diuretics is statistically significantly different in relation to the number of risk factors ($p = 0.004$). Patients without risk factors use diuretics less frequently compared to patients with one risk factor ($p = 0.028$) and to patients with two risk factors ($p = 0.005$). NYHA II is dominant in all three groups (52.70%, 76.90% and 61.50%). In the group without risk factors, 38.20% of patients had NYHA I. In the one risk factor group, 7.70% of patients had NYHA II and 15.40% had NYHA III. In the group with two risk factors, 38.50% of patients had NYHA III. A statistically significant difference was determined in the frequency of various NYHA stages in the examined groups ($p = 0.001$).

Ventricular fibrillation happened in six patients (10.9%) without risk factors, three patients with one risk factor (23.10%) and six patients with two risk factors (46.20%). Five patients (9.10%) without risk factors died, three patients (23.10%) with one risk factor and six patients (46.20%) with two risk factors. A statistically significant difference was

determined in the frequency of ventricular fibrillation (X^2 = 7.728, p = 0.021) and fatal outcome (X^2 = 9.078, p = 0.011) in relation to the number of risk factors (Table 3).

Table 3: Correlation between number of risk factors with fatal outcome, ICU treatment and length of stay

Parameter	**Number of risk factors**			**X^2/***	***p***
	Without n = 55	One n = 13	Two n = 13		
Fatal outcome	5 (9, 10)	3 (23, 10)	6 (46, 20)	9.078	0.011
ICU*	42 (76, 409)	10 (76, 90)	12 (92, 30)	1.985	0.371
Length of stay in ICU	3.17 ± 2.06	3.90 ± 2.99	3.83 ± 2.59	0.678*	0.712

Abbreviations: *ICU – Intensive care unit.

The patients without risk factors had longer survival than patients with one or two risk factors but there was no statistically significant difference (p = 0.079). Survival median in patients without risk factors was 28.00 days (95%CI, 19.53-28.52), in patients with one risk factor it was 18.00 days (95%CI, 10.84-19.16 days) and in patients with two risk factors it was 15.00 days (95%CI, 3.64-26.36 days) [Figure].

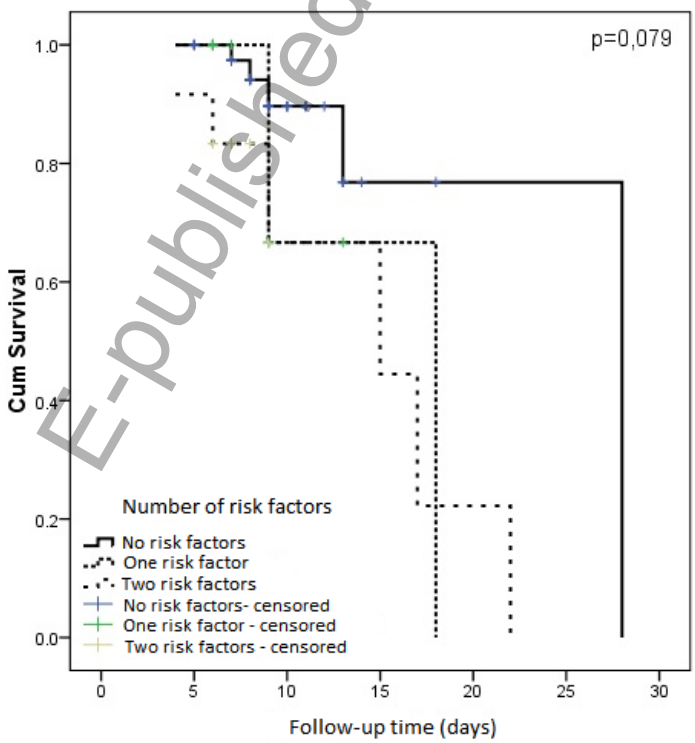

Figure: Kaplan-Meier survival curve in relation to the number of risk factors.

Cox regression analysis showed that patients with two risk factors were four time more prone to fatal outcome compared to patients without risk factors (HR 4.023, $p = 0.038$). In patients with one risk factor, risk quotient was not statistically significant (Table 4).

Table 4: Cox regression analysis in relation to the number of risk factors

Predictor	HR	95%CI	*p*
No risk factors	Control group		
One risk factor	2.760	0.611-12.471	0.187
Two risk factors	4.023	1.082-14.962	0.038

DISCUSSION

The RCRI is popularised as best currently available index in forecasting of major cardiovascular complications in non-cardiac surgery patients (1.5). Nevertheless, RCRI may underestimate patients with great cardiac risk because of rejection of patients with emergency operations and major non-laparoscopic operations in abdominal, vascular and orthopaedic surgery (9). It is better in prediction of major cardiac events then mortality (10). We concluded that summation of a various risk factors is important short-term mortality predictor. Increased short-term (30 days) mortality was recognized in patients with two risk factors. High short-term mortality rate of 17.3%, in comparison to other studies, we interpreting as an impact of higher average age of 71.30 ± 6.62 years (11, 12). Elderly patients (> 70 years) planed for major non-emergent non-cardiac surgery were at raised risk of perioperative complications, mortality and length of hospital stay (13). Prospective study, which enrolled 2375 surgical patients, reported 8.8% mortality rate in patients older than 60 years in comparison with 1.9% mortality in younger group (14). Our investigation included 35.8% patients suffered from diabetes mellitus (28.4% with oral antidiabetic therapy and 7.4% with insulin regimen) which is disease with confirmed short-term and long-term mortality (15).

We were enlisted large group of patients (49.4%) with malignancy. Particularly this patient subgroup might have elevated risk of cardiac mortality after surgery. We believe that such a high mortality was the consequence of malignant malnutrition and cardiac wasting in high stages of oncologic diseases (16), which were the majority in our study. All patients included in our investigation were at severely impaired physical status (III and higher classes) according to ASA Physical Status Classification (17). This is well known and simple predictor of in-hospital and long-term mortality, although predominantly depends of subjective perception of physician and roughly divided into classes (18). Arterial hypertension was the most frequent risk factor in our research group. Although it is independently associated with increased risk of intraoperative arrhythmias and hypotension (19) these alterations may prone patients to postoperative adverse events (20, 21). Our group of risk factors and other factors from studies which examinate the same problem suggest a need for establishing new short-term mortality risk systems.

CONCLUSION

We concluded that there is high short-term mortality rate in older patients undergoing major non-cardiac surgery. Group of patients with only two of large palette of preoperative risk factors have statistically significant higher short-term mortality.

ACKNOWLEDGEMENTS

The author wish to thank the attending physicians Vladan Cvetanović, Nenad Jovanović and Sonja Stamenić, without whose efforts this study would not have been possible.

REFERENCES

1. Kristensen SD, Knuuti J, Saraste A, Anker S, Botker HE, Hert SD et al. 2014 ESC/ESA Guidelines on noncardiac surgery: cardiovascular assessment and management: The Joint Task Force on noncardiac surgery: cardiovascular assessment and management of the European Society of Cardiology (ESC) and the European Society of Anaestesiology (ESA). Euro Heart J 2014; 35: 2383–431.
2. Rich MW, Chyun DA, Skolnick AH, Alexander KP, Forman DE, Kitzman DW et al. Knowledge gaps in cardiovascular care of the older adult population: a scientific statement from the American Heart Association, American College of Cardiology, and American Geriatrics Society. Circulation 2016; **67:** 2419–40.
3. Devereaux PJ, Sessler DI. Cardiac complications in patients undergoing major noncardiac surgery. N Engl J Med 2015; **373:** 2258–69.
4. POISE Study Group, Devereaux PJ, Yang H, Yusuf S, Guyatt G, Leslie K et al. Effects of extended-release metoprolol succinate in patients undergoing non-cardiac surgery (POISE trial): a randomised controlled trial. Lancet 2008; **371:** 1839–47.
5. Lee TH, Marcantonio ER, Mangione CM, Thomas EJ, Polanczyk CA, Cook EF et al. Derivation and prospective validation of a simple index for prediction of cardiac risk of major noncardiac surgery. Circulation 1999; **100:** 1043–9.
6. Fowler AJ, Ahmad T, Phull MK, Allard S, Gillies MA, Pearse RM. Meta-analysis of the association between preoperative anaemia and mortality after surgery. Br J Surg 2015; **102:** 1314–24.
7. Mathew A, Devereaux PJ, O'Hare A, Tonelli M, Thiessen-Philbrook H, Nevis IF et al. Chronic kidney disease and postoperative mortality: a systematic review and meta-analysis. Kidney Int 2008; **73:** 1069–81.

8. The Criteria Committee of the New York Heart Association. Nomenclature and Criteria for Diagnosis of Diseases of the Heart and Great Vessels. 9th ed Little, Brown & Co; Boston, Mass: 1994.

9. Eagle KA, Berger PB, Calkins H, Chaitman BR, Ewy GA, Fleischmann KE et al. American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee to Update the 1996 Guidelines on Perioperative Cardiovascular Evaluation for Noncardiac surgery). ACC/AHA guideline update for perioperative cardiovascular evaluation for noncardiac surgery-executive summary report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee to Update the 1996 Guidelines on Perioperative Cardiovascular Evaluation for Noncardiac Surgery). Circulation 2002; 105: 1257–67.

10. Boersma E, Pieper KS, Steyerberg EW, Wilcox RG, Chang WC, Lee KL et al. Predictors of outcome in patients with acute coronary syndromes without persistent ST-segment elevation: results from an international trial of 9461 patients. Circulation. 2000; **101:** 2557–67.

11. Abelha F, Maia P, Landeiro N, Neves A, Barros H. Determinants of outcome in patients admitted to a surgical Intensive Care Unit. Arq Med 2007; **21:** 135–43.

12. Sakr Y, Krauss C, Amaral AC, Réa-Neto A, Specht M, Reinhart K et al. Comparison of the performance of SAPS II, SAPS 3, APACHE II, and their customized prognostic models in a surgical intensive care unit. Br J Anaesth 2008; **101:** 798–803.

13. Polanczyk CA, Marcantonio E, Goldman L, Rohde LE, Orav J, Mangione CM et al. Impact of age on perioperative complications and length of stay in patients undergoing noncardiac surgery. Ann Intern Med 2001; **134:** 637–43.

14. Crandon IW, Harding H, Carpenter R, Branday JM, Simeon DT. Surgery in the Elderly: Is Age a Risk Factor? West Indian Med J 2005; **54:** 171–5.

15. Krolikowska M, Kataja M, Pöyhiä R, Drzewoski J, Hynynen M. Mortality in diabetic patients undergoing non-cardiac surgery: a 7-year follow-up study. Acta Anaesthesiol Scand 2009; **53:** 749–58.

16. von Haehling S, Doehner W, Anker SD. Nutrition, metabolism, and the complex pathophysiology of cachexia in chronic heart failure. Cardiovasc Res 2007; **73:** 298–309.

17. Owens WD, Felts JA, Spitznagel EL Jr. ASA physical status classifications: a study of consistency of ratings. Anesthesiology 1978; **49:** 239–43.

18. Vacanti CJ, VanHouten RJ, Hill RC. A statistical analysis of the relationship of physical status to postoperative mortality in 68,388 cases. Anesth Analg 1970; **49:** 654–66.

19. Beyer K, Taffé P, Halfon P, Pittet V, Pichard S, Haller G, Burnand B; ADS study Group. Hypertension and intra-operative incidents: a multicentre study of 125,000 surgical procedures in Swiss hospitals. Anaesthesia 2009; **64:** 494–502.

20. Reich DL, Bennett-Guerrero E, Bodian CA, Hossain S, Winfree W, Krol M. Intraoperative tachycardia and hypertension are independently associated with adverse outcome in noncardiac surgery of long duration. Anesthesia and Analgesia 2002; **95:** 273–7.

21. Rohrig R, Junger A, Hartmann B, Klasen J, Quinzio L, Jost A, et al. The incidence and prediction of automatically detected intraoperative cardiovascular events in noncardiac surgery. Anesthesia and Analgesia 2004; **98:** 569–77.